

PUBLIC HEALTH ASPECTS OF FOOD PRESERVATION *

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THE PRESERVATION of food is a major industry in nearly every country. The reasons for this are obvious. Agricultural raw food products attain their prime and maturity at different seasons, others are produced only in certain parts of the country. In some sections there are abundant harvests, in others crop failures. Our population is two-thirds urban. Food must be preserved for the lean seasons, for the non-producers, for the non-agricultural regions and for the purpose of satisfying an omnivorous American appetite for variety in all places and seasons.

GENERAL METHODS OF PRESERVATION

1. Application of heat, such as canning and preserving, pasteurization, evaporation, sun-drying, dehydration and smoking
2. Application of cold, as in cold storage, refrigeration and freezing
3. The use of chemical substances such as salt, sugar, vinegar, benzoic and lactic acids
4. Fermentation, examples being acetic, lactic, alcoholic, etc.
5. Such mechanical means as vacuum, filtration and clarification processes, devices or agents for preventing chemical deterioration or bacteriological spoilage (The use of oil, paraffin and waterglass are included here.)
6. Combinations of two or more of the above

HEALTH ASPECTS OF PRESERVATION BY HEAT

Probably preservation by heat is the most important of all these methods because on it are based the immense canning, beverage and drying industries.

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The raw products for the food factory must be mature, sound, and free from filth. Fruits, vegetables and marine products should be carefully washed in a clean building provided with modern sanitary devices. Raw products may be contaminated with harmful organisms. Thorough sorting and cleaning materially reduces the number of microorganisms passing into the container before sealing and thus further reduces their chance of survival after processing.

Much has been written^{1, 2, 3} concerning both cannery sanitation and the physical examination of workers in food factories. The former is absolutely necessary, the latter, highly desirable. The attempt has been made to point out that inasmuch as food is sterilized in tin cans or glass jars, that the methods of preliminary handling are relatively unimportant. Although it is true, and fortunately, too, that the high temperatures used to process canned foods do destroy practically all living microorganisms, the chance of survival increases with the initial contamination. Furthermore, unclean, mangled, or partly decomposed foods make a very poor appearance in the can and sell at low prices.

That sanitation is a factor in the production of sound and safe canned foods there appears to be no doubt. Nearly all states now possess suitable sanitary laws applicable to food manufacturing plants and what is better still, considerable effort is being made to enforce them. The milk sanitarians long ago found that pasteurization without inspection at the source was often taken by the producer as a

license to produce dirty, low grade milk. The processing of canned foods acts in much the same way as the pasteurizing of milk. It is a final check, though of course in the case of foods the hermetically sealed can or jar prevents recontamination.

EFFECT OF PROCESSING

Probably the most important point of all in canning and preserving is the temperature of the process or cook and how long this is maintained. Thanks to the many careful investigations already carried out in this field, canners now have at their disposal sufficient information to enable them to pack and market a high grade of canned foods upon whose wholesomeness the public may safely depend. The trend⁵ in botulism outbreaks is downward and with a greater proportion each year due to home packed foods. Education as to the necessity of properly processing vegetables, meats and fish to avoid the possibility of food poisoning, should be carried to the home. Most commercial packers are now doing everything within their power to lessen the dangers of food poisoning from commercially canned foods. The presence of *Cl. botulinum* in soil or dust almost everywhere makes it necessary to process non-acid vegetables, meats and marine products and cereals, at a temperature which precludes the survival of any spores. In the case of meats, marine foods, and non-acid vegetables it has been found unsafe to process or cook at the temperature of boiling water (212° F.). For safety, a pressure cooker is necessary. By acidification with organic acids, it is possible to secure sterility at 212° F.

The aim of the commercial packer is sterility in his finished pack—this end has been practically attained in the case of canned fruit and some vegetables. Some other canned foods contain viable bacteria, which, though probably harmless, are more resistant to heat than even the bacillus of botulism.

It is now known that many of our canned vegetables, meats and marine foods are not sterile.^{4, 5, 6, 7} Furthermore, it is almost impossible to prevent occasional poor seams resulting in leaky cans, mistakes in processing, or other accidents. A cannery is a very busy place. That more mistakes are not made has always been a marvel to me.

UNSAFE CANNING LITERATURE

One very serious situation, it seems, has been entirely overlooked. This concerns itself with the large number of books, bulletins, circulars, recipes, and canning guides which are sadly out of date and which describe faulty and positively dangerous methods of canning vegetables, meats and fish.

The writer has personally investigated at least two fatal outbreaks of botulism which were directly traceable to erroneous canning directions. Something should surely be done to curb the publication and distribution of such dangerous literature. At this time much credit should be given to the Bureau of Home Economics, U. S. Department of Agriculture, for their courage in adopting safe and sane methods of canning and distributing them in bulletin form⁹ to replace former ones which were decidedly objectionable from a public health viewpoint. Likewise the Bureau of Chemistry, U. S. Department of Agriculture, the National Canners' Association and certain states, notably California, have carried on excellent publicity campaigns for the enlightenment of canners and consumers alike.

OTHER FACTORS

It was feared and even openly stated some years ago that the process of canning destroyed the vitamins of the raw products. The excellent researches of Eddy and Kohman¹⁰ and others have all fully demonstrated that canned food retains nearly all of its original vitamin content.

As to the adulteration of canned fruits and vegetables, there is little to be said

primarily because much of the adulteration which occurs, for example the substitution of apple pectin in berry jellies, tomato juice for tomatoes, and many others, do not have much public health bearing. The suppression of decomposed foods and those containing added harmful preservatives, is a laudatory work and one well done by state and federal authorities.

Savage⁵ in England has claimed that the toxins of the Gaertner and similar bacilli are at times thermostable and produce symptoms of poisoning even though the canned food be sterile. He reported the presence of toxin in canned marine products and meats. This is a very interesting as well as important field. Geiger and his associates^{11, 12} likewise have reported the formation of toxins which withstand a degree of heat. The whole paratyphoid-enteritidis group of bacteria need thorough study, particularly in their relationship to food poisoning.

It is known that there are certain infections and dermatoses caused by handling some foods in canneries. Both tuna and pears cause a distressing dermatitis among some workers, while staphylococcic infections are common among fishermen and other workmen handling marine products. In certain sensitive individuals, hay fever and protein sickness may be caused by handling fruit or other foods.

Industrial accidents in food factories will merely be mentioned here. Let it suffice to say that such accidents in canneries and beverage plants are common enough, though seldom of a serious nature. The various state labor and industrial commissions have done excellent work in the protection from accidents and in the improvement of working conditions of factory employes.

Perhaps it should be mentioned here that in most states the 8-hour day law for women workers is not enforced in factories packing perishable foods. This non-enforcement may result in the impairment of the health of some of the

women, for surely the work is as trying as other labor.

UNFOUNDED PREJUDICE

There is a deep-seated prejudice against canned foods, especially in the minds of older people and in certain sections of the country. Thousands of cases of illness have been wrongfully attributed to them.^{11, 13} They have been merely a convenient peg upon which the unknown cause of the illness could be hung. It is probable that canned foods are among the safest that are consumed.

The old "ptomaine" theory of food poisoning has been relegated to the past as modern researches have demonstrated that most decomposition products are relatively harmless, and that nearly all acute gastrointestinal disorders are due to specific bacteria. After all, the total number of deaths from botulism is insignificant when compared with even rare or extraordinary causes of death.

TIN CANS AND GLASS JARS

The writer has found¹⁴ that empty cans and jars before use contain at times very large numbers of microorganisms besides dust and other debris. Many cannery workers do not wash their cans previous to use, though most glass packers and bottlers do. Many cans or jars contained from a few hundred to over 200,000 microorganisms comprising many species. Some of these were very heat-resistant sporulating bacilli such as are often found in insterile canned foods. That the source of some of these is the unclean container, there is no doubt. It may well be that such organisms as *Cl. botulinum* are present in these cans. It is possible that the two recent outbreaks of botulism^{15, 16} attributed to canned sardines were contaminated in just this manner, for so far as is known to me this organism has not been encountered in sea water. Food officials should insist on all food containers being thoroughly washed previous to use. Wisconsin has already taken a lead which other states may well follow.

As to the supposed dangers of dissolved tin and iron in canned foods, we have no reliable data to substantiate such claims.⁹ Tin plate used for can manufacture is lead-free. Lead solder is never used in contact with the food. Even where corrosion is marked it is probable that as long as the contents are palatable, there need be no fear of metallic poisoning.¹³

Although British investigators¹⁸ have called attention to the presence of glass particles in foods packed in glass, they also report that certain foods may dissolve arsenic, lead or boric acid from the glass, thus creating further objections. Until these results have been adequately checked in this country we cannot but believe that there is no great danger arising from the use of modern glass containers in the food packing industry.

Struvite crystals (magnesium ammonium phosphate) have been found rather commonly in canned shrimp, crab and salmon.^{19, 20} In a number of instances these hard gritty masses have been mistaken for glass. The substance is entirely harmless and appears to be a natural constituent of some canned foods.

An interesting sidelight is the prevailing idea that canned foods must be removed from the container immediately upon opening. Even many labels tell the purchaser to do this. At least two states, Oregon and Kansas, have regulations prohibiting the use of tin cans for food storage or cooking. As a result of a circular letter addressed to about 50 commercial canners, not one gave a sound reason for such a statement. There is in fact no good reason for emptying the can contents immediately. It would appear that if only a portion is to be consumed that the cleanest and safest place for the remaining portion for a day or so is in the original container.

DRYING AND DEHYDRATION

Sun drying as well as artificial dehydration is a widely-used method of pre-

serving fruits, vegetables, fish and meats. The practice is much more commonly utilized in the Orient and in Europe and Africa, than in this country. There are few important public health aspects of drying. The handling of the product both during and after drying may contaminate the food. Of course, only sound raw products should be used to begin with, and they should be handled in such a manner as to preclude contamination. Vermin, flies and filth must be rigorously excluded. Our native dried raisins, figs, prunes, apples and fish are, in general, carefully prepared and provide an excellent and safe food for the American public. This is more than can be said for such imported dried products as Smyrna figs, Greek currants or Algerian dates. Many shipments of these are very dirty and badly infested with insects. The sulphuring of dried fruits has long been practiced. Whether or not sufficient sulphites remain in the fruit to constitute a health hazard is debatable.

The modern method of packing and marketing dried fruits and vegetables in sealed paper or metal containers is a very commendable practice.

COLD STORAGE

Many states now have adequate cold storage laws. Cold acts as a deterrent to microbial action and there has been little danger to the public health from this class of foods. Millions of pounds of cold-packed fruits, frozen fish and meats, cold storage butter and eggs are annually consumed not only without injury but of unmeasured benefit to our national health.

Here again only sound, fresh foods should be placed in cold storage or frozen, since spoilage rapidly takes place upon removal to ordinary temperatures. It is known that members of the typhoid group may survive long periods of time in ice, ice cream or in other frozen products and for this reason great care must be taken not to refrigerate or freeze contaminated raw products.

SUGAR, SALT, VINEGAR AND OTHER CHEMICAL SUBSTANCES AS PRESERVATIVE AGENTS

Methods of preservation of food by the use of salt or vinegar are very ancient. The use of sugar is a relatively later practice though now widely prevalent. There are few organisms capable of withstanding the ordinary concentrations of sugar, salt or vinegar used in food preservation, and few cases of illness have been reported due to the eating of such substances as green olives, pickles, kraut, preserves, jellies, syrups, citron or candied fruits. Only clean sound products should be pickled or salted and care must always be taken that sufficient concentration of the preservative is present to prevent spoilage. Likewise, ordinary common sense precautions will guard against contact contamination upon removal from the brine, pickle or syrup.

Here mention must be made of the use of harmful preservatives such as borates, salicylates, and formates. They are now rarely found in food products. A new preservative, so far as I am aware, was our discovery of last year in Seattle of hexamethylenetetramin (urotropin), in imported Japanese and Siberian caviar. This is a most unusual substance which forms formaldehyde only if decomposition of souring occurs. Benzoate of soda, alum, nitrites and other agents concerning the harmfulness of which there is well divided opinion, are legally used in our foods and are undoubtedly of some public health significance, particularly when considerable quantities are consumed.

There has been considerable adverse criticism^{21, 22} given the recent decision²³ of the Federal Bureau of Animal Industry permitting the use of nitrites in meats without declaring their presence. The use of hypochlorites in ice^{24, 25} for refrigeration and preservation of fish and other foods is effective and harmless. Carbon dioxide ice is likewise without objection.

PRESERVATION BY FERMENTATION

Since the enactment of the National Prohibition Act we have very little alcoholic fermentation being legally carried on in this country. There is, however, a great deal of illegal brewing and distilling. The use of copper and zinc stills and containers has caused much trouble because of the solvent action of the fruit, vegetable or cereal mash. Many cases of heavy metal poisoning have been attributed of late to this source.

The consumption of green and improperly fermented liquors containing aldehydes and higher alcohols is undoubtedly a question of major public health significance. On the other hand there are few public health phases concerning the legitimate fermentation industries.

PRESERVATION BY VACUUM, FILTERING ETC.

Inasmuch as these preservation methods are usually practiced in connection with other methods no peculiar public health problems have presented themselves.

SUMMARY

To summarize, the principal methods of food preservation are canning, pasteurizing, drying, smoking, cold storage and freezing, use of such substances as salt, vinegar, sugar and chemical preservatives, fermentation, mechanical agents and combinations of these.

The principle of using sound, fresh and clean raw products is essential to the success of all methods of preservation. Likewise clean, disease-free workmen handling the food in a sanitary manner, in clean surroundings is another essential common to every method.

Similarly after the process, all preserved foods must again be protected against extraneous contamination. By far the most important methods in commercial use are the use of heat in canning, pasteurizing, smoking and drying foods. The principal public health aspect of canning lies in the destruction of possibly

harmful bacteria by a process or cook of sufficiently high temperature and held for a sufficient length of time. Although some sound canned foods are not sterile, this is no cause for alarm because of the harmless character of nearly all these organisms. Botulism outbreaks are rare and are confined chiefly to home canned foods, though commercially canned foods are occasionally implicated.

It has been pointed out that all empty containers should be thoroughly cleaned before packing food therein due to danger of introducing resistant and harmful organisms by this means.

Occupational accidents, dermatoses and infections due to handling certain foods and non-enforcement of the 8-hour laws for women in canneries are additional public health phases of the preservation industry.

The presence of thermostable toxins of the paratyphoid-enteritidis group in canned foods has been reported, but the data are not yet sufficiently convincing to state with certainty just how serious this menace may be.

Many decomposed products aside from being offensive and repulsive to the senses, do not have the public health significance formerly attributed to them.

Researches have proved that the vitamins, particularly the antiscorbutic factor, are not greatly injured in the process of canning foods. From a health standpoint, this is a very important finding to the entire nation.

The canning guides, bulletins, circulars and recipes distributed by state agencies, magazines, women's clubs and manufacturers of canning equipment contain many erroneous statements and faulty methods which have been directly responsible for several outbreaks of botulism besides causing great losses through spoilage of good human food. Accurate and safe directions for preserving food products should be prepared by state colleges, and similar agencies in order that any present faulty, unsafe methods may be rectified.

Adulteration of canned, dried or smoked food is at present of minor significance from a public health standpoint. This is due largely to excellent law enforcement by the several federal and state food officials.

Dried foods and cold-stored foods likewise present few public health problems.

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